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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/781,920	12/30/96	FUKUNAGA T	0756-1614

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EXAMINER	
PADGETT,M	

ART UNIT	PAPER NUMBER
1762	24

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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

U.S. G.P.O. 2000 ; 465-188/25266

Office Action Summary

Application No.	Applicant(s)
08/781,920	Fukunaga et al
Examiner	**Group Art Unit**
M.L. Pulsett	1762

—The MAILING DATE of this communication appears on the cover sheet beneath the correspondence address—

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, such period shall, by default, expire SIX (6) MONTHS from the mailing date of this communication .
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Status

☒ Responsive to communication(s) filed on 4/26/99, 6/24/99 + 11/22/99.

☒ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle,* 1935 C.D. 1 1; 453 O.G. 213.

Disposition of Claims

☒ Claim(s) 24-63 is/are pending in the application.

Of the above claim(s)_____ is/are withdrawn from consideration.

☐ Claim(s)_____ is/are allowed.

☒ Claim(s) 24-63 is/are rejected.

☐ Claim(s)_____ is/are objected to.

☐ Claim(s)_____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The proposed drawing correction, filed on_____ is ☐ approved ☐ disapproved.

☐ The drawing(s) filed on_____ is/are objected to by the Examiner.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Pri rity under 35 U.S.C. § 119 (a)-(d)

☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 11 9(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number)_____.

☐ received in this national stage application from the International Bureau (PCT Rule 1 7.2(a)).

*Certified copies not received:_____.

Attachm nt(s)

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 29

☐ Interview Summary, PTO-413

☐ Notice of Reference(s) Cited, PTO-892

☐ Notice of Informal Patent Application, PTO-152

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Other_____

Office Acti n Summary

1. Claim 32 has a minor informal amendment in line 10, where an extra "so" has been included after "film", without proper amendment procedures. As it does not effect the meaning or the grammar significantly, no rejections are required by the examiner.

2. Claims 38, 47 and 59-63 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

New claims 59-63, all use the wrong article in the term "a temperature", because the independent claims all previously introduced this limitation.

Claim 38 remains confusing and ambiguous, because as written it appears to contradict the independent claim 32 from which it depends by requiring a concentration of catalyst material where the source of the catalyst was explicitly excluded from being added and no process step in either claim ever necessarily causes it to arrive there. If the catalyst is NEVER added it can't be present where claim 38 apparently is trying to require it to be, however one might consider the lower concentration to include zero, but that is debatable, hence ambiguous. Clarification in the claims is needed. For purposes of examination and consistency a second concentration of zero will be considered to read on claim 38, as well as the alternative were the catalyst material may be considered to migrate during subsequent processing such as the first heating where lateral crystal growth proceeds, thus adding the catalyst via a process other than solution to the second potions. The examiner agrees with the applicant's comments that the specification supports the second

option, but the claim language does not necessitate it, so does not provide or mean such a mechanism. Claim 47 need analogous clarification.

Claims 31, 40, 49 and 55 are confusing and contradictory with respect to their independent claims, because one cannot promote further crystallization by melting what is already there! That one can crystallize from melted material and the degree of crystallization therefrom, is not at issue here, but the contractions in the particular word choices. The irradiating step treats "said crystallized semiconductor film .... to promote further crystallization...", ie. enlarging or enhancing already present crystal size, etc. If you melt it , what's there is destroyed and recrystallized, which is NOT what the independent claims are doing.

3. Claims 56-58 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for crystallization process using catalyst, as in the preceding claims, does not reasonably provide enablement for crystallization that need not involve catalyst. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims. As specified in the abstract and Summary, applicant's invention in directed towards a crystallization process for amorphous Si that uses catalysts. On page 9 of applicant's remarks in the 9/23/98 amendment, applicants state that their intent is to delete the catalyst from the claimed steps, which is in direct contradiction to the stated objective of the specification. Applicants' previously cite p. 18 of the specification for support, ie. the last page of embodiment 1, which starts on p. 15, and states in its first sentence that it uses a catalyst! Hence, while p. 18 teaches use of a pulsed

excimer laser and multiple shots, all the examples that discuss crystallization also discuss use of a catalyst, such as Ni. The only non-Ni (or catalyst) sample to be found is sample No. 6 in Fig. 8, which caused crystallization only for comparison, and DOES NOT USE the claimed temperatures, but 600° C for 24 hours! None of the generic discussion specifically pertains to Figure 8, No. 6 or provides for the claimed process, ie. provides for heating + irradiation + a lower temperature range. Page 40, lines 17-25 cited by applicants does not correct these defects, nor does page 43, hence claim 56-58 are CLEARLY NOT ENABLE, and contain NEW MATTER.

4. Claims 24-63 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. As noted above, crystallization without catalyst as claimed in 56-58 is not taught in the original specification, hence is New Matter.

In independent claims 24, 32, 41 and 50, the claim of a second heating with an open ended temperature range is NEW MATTER, as is annealing the crystallized Si film in a hydrogen containing atmosphere. Applicants' citation of p. 11, lines 6-10 which gives a maximum temperature range, to say(support) that they don't need one was NOT convincing. No disclosure of only a minimum required temperature was found, no open ended unlimitedly high temperatures, in fact temperature disclosure for the second heating step were either specific temperatures, such as 550° C for 4 hours in N_2 (embodiments 1, 2, 5 and 6), or well defined ranges of 450° - 750°C,

but when the substrate is glass limited to a maximum of 600° C. Since the teachings in the specification stress the ability to use low temperature to crystallization due to the catalyst, the open ended temperature claim is contrary to the spirit of the disclosed invention, as well as unsupported. Applicants have added new claims 59-63 without bothering to cite any support, and the examiner did not find any for this limitation that gives a functional condition for the temperature end point, instead of a numeral one.

There was NO disclosure found, of annealing the Si-film treated as claimed in an atmosphere comprising hydrogen (note open language). The closest disclosure to what was claimed, was in the last step of producing a TFT device in embodiments 3, 4, 5, 6 and 8, the otherwise completed device was annealed in H_2, usually at 350°C and 1 atm for about 30 min or 1-2 hr, but in all cases absolutely NONE of the previously deposited and treated Si film was exposed to the H_2 atmosphere, so this additional to the claims is NEW MATTER. Furthermore, even if the step was being applied to the correct product as disclosed, the annealing atmosphere is broader than that taught in the specification, since H_2 is only of one of a large set of gases that are hydrogen containing. Also, none of the embodiments that have the H_2 anneal of the TFT device, use the initial heat treatment before the irradiation, but instead use both heat and irradiate without first only heating to crystallize. Only embodiment 1, which does not give the steps for various layer in the device formation, teaches a first, separate heating step and definitely has NO H_2 annealing associated therewith. Applicant's attempt to cite the last step of embodiment 4 as support, shows a fundamental lack of understanding of what constitutes support (or an attempt

insult the examiner's intelligence). While a reference that provided Embodiment 4 as an example might be said to read on the claims for the reasons given by applicant(a specific example may read on a broad concept), that same example in the specification do NOT provide support for the board claim limitation that includes annealing the treated Si film (without the 3 to 5 superimposed layers of the embodiment) in an atmosphere that merely need contain H, no other conditions limited. Page 28 heat treatment in a NITROGEN atmosphere, hardly supports annealing in H_2, as alleged by applicant.

Claims 31, 40, 49 and 50 also appear to contain New Matter, because absolutely NO support for changing "fuses" to -- melts -- was found in the original specification. While what applicants intended by fused was unclear from the specification and context (why it was originally objected to), there was NOTHING in the text to lead one to believe melting had taken place. Quite the opposite in fact, since one cannot improve or increase or promote further crystallization of a solid phase by making it liquid, which only might provide conditions to enable recrystallization, ie. making crystals go away can't increase, etc., those same crystals, just make different or new ones. That one possible definition of fused may require that the substrate have been melted, does NOT necessitate melting in the specification, because as shown by the applicant's dictionary citation, "united by heating" which need not include melting is also a definition and applicable to the specification's use of fused. Neither do the synonyms listed therein. Is this a translational discrepancy? Information to that effect might usefully resolve this issue.

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321© may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

6. Claims 24-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohtani et al (5,543,352) in view of Zhang et al (5,529,937) or visa versa, optionally in view of Liu et al (826) or Zhang et al (291).

Claims 24-63 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-20 of U.S. Patent No. 5,543,352 to Ohtani et al in view of Zhang et al (937), optionally in view of Liu et al (826) or Zhang et al (291).

Note that if the NEW MATTER was removed form the claims the certified translation of JP. Ap. No. 6-225851 would be effective.

Ohtani et al claim (hence teaches) all aspects of applicant's claims, except the second thermal heating step; the formation of a transistor with channels (claims 41-49); the claimed melting (previous fusing) step whose meaning is not particularly clear or supported, but may be considered covered by teachings of light or laser light used in the same fashion; and the H_2 annealing step which is also unsupported by applicants' disclosure. The specification of Ohtani et al (ie. for the 103 rejection) explicitly teaches the use of excimer lasers, which are inherently pulsed lasers for use in the laser irradiation step of the crystallization, hence covering that aspect of claim 56. See col. 7, lines 10-15 in Ex. 1; col. 8, lines 1-8 in Ex. 2; col. 13, lines 16-28 in Ex. 5 and col. 15, lines 1-8 in Ex. 6 for use of various excimer lasers (KrF and XeCl) as claimed. It is further noted that Ex. 3 on col. 10, lines 38-45; Ex. 4 (called 5) in col. 12, lines 55-60; Ex. 5 in col. 14, lines 40-42 and Ex. 6 on col. 16, lines 5-8 teach annealing the final TFT devices produced in a hydrogen atmosphere, under conditions and circumstances as taught in applicant's specification. Granted, to apply this step to the claim one has to ignore its context in the same fashion applicants did to amend the claims, however in light of applicants' specification this step is clearly covered for purposes of the 103 rejection. With respect to the judicial double patenting and in light of context in the specification, it would have been obvious to preform conventional annealing procedures as claimed, to some unspecified final product, depending on what that product was and the intervening steps that produced it, hence that may have produced various damage that needed correcting or require particular final surface properties, etc. At present the

claims lack context for the H_2 annealing as disclosed in the specification to be meaningful (or supported).

The patent Zhang et al ('937) teaches and claims a very similar process with many overlapping steps, however it also teaches heating of the silicon film before, during and possibly after the irradiation step. Particularly see, claim 56, or col. 8, lines 12-23, or col. 15, lines 18-51 and Figure 5, where 3 periods of heating are discussed in relationship to the light irradiation step, such that the third step with 200-500°C corresponds to applicants' claimed second heating, with overlapping temperature ranges. The irradiation step in Zhang et al (937) may use either IR or laser light to promote further crystallization (col. 7, lines 60-67; col. 9, lines 46-59; col. 12, lines 20-24), but the specific type of laser used at that step is not specified, however later laser anneal steps (after doping) applied to the Si film use excimer lasers (ie. pulsed), hence it would have been obvious to one of ordinary skill in the art to use the same types of lasers in the early step or in Ohtani et al's laser irradiating claims, because in both instances lasers are used to effect the crystallization of the silicon film in analogous fashions. See col 10, lines 42-51 and col. 16, lines 49-58 for KrF lasers and parameters used for annealing the Si film. Zhang et al (937)'s claims, such as 12, appear to be after or possibly during the irradiation, but have unclear temporal language. It would have been obvious to one of ordinary skill in the art to apply such heating in the Ohtani et al reference due to the similarities of the processes and taught benefit of reducing defects and dangling bonds. Zhang et al particularly teaches the use of nitrogen in the initial heating to crystallize and after irradiation H_2 ambient instead of N_2 as claimed by applicant's

present claims 25, 33, 42 and 51 in order to neutralize dangling bonds (col. 7, lines 52-59; col. 8, lines 19-30; col. 9, lines 15-59 and col. 11, lines 11-16, etc.), however inert atmospheres would also have been expected to be effective as they are conventionally used for annealing procedures, hence would have been expected to have been effective especially considering the initial use of N_2 when heating to crystallize. Alternatively, Zhang et al (291) or Liu et al (826) teaches the use of Ar or other inert atmospheres for Ni or Pd - catalyzed annealing procedures of Si films at temperatures within the presently claimed range, although slightly higher than the Zhang et al ('937) third temperatures (col. 4, lines 20-48 and Ex. 2). Liu et al thus provides cumulative evidence that inert atmospheres, hence N_2 would have been expected to be effective for the annealing of Ohtani et al in view of Zhang et al (937) and Liu et al.

The use of H_2 gas when annealing after irradiation in Zhang et al (937) would have made a subsequent H-anneal step in Ohtani et al further obvious due to the explicit teaching on the effects on any dangling bonds that may remain. Note that this concept matches applicants' amended claims, but in Zhang et al (937) is used at a totally different time than in applicant's specification.

Zhang et al (937) also teaches use of their products, as claimed, for producing channel forming areas in transistor devices (col. 15, lines 52-59), hence use of the analogous features in an Ohtani et al product for such would have been obvious.

As noted above, claims 25, 33, 42 and 57 differ by requiring their atmosphere to be N_2, however Zhang et al (291) shows that for annealing semiconductors using heat, that N_2 is known to be an inactive atmosphere, hence obvious in view of the annealing procedures of the primary

references, which are also a heat treating α-Si to cause crystallization. In Zhang et al (291) see abstract and claims, especially 1-10.

In Zhang et al (937) for further relevant teaching see abstract; Fig. 1 (etc); col. 4, lines 1-32 and 59 - col. 5, line 20 and 58 - col. 6, line 52, noting both thermal and radiation treatment appear to be taught to convert the amorphous area entirely to crystalline with col. 5, lines 5-10, discussing heating to 600°C in conjunction with using laser light. Particularly see, col. 9, lines 15-45 for α-Si with Ni to promote crystallization where first heating at 550°C in N_2 or Ar for 4 hrs is taught, then lines 46-59 where laser light is taught to "further promote" crystallization, which is consistent with applicant's claimed limitations. Lines 55-59 discuss the effect on dangling bonds and reduction of defects. Col. 9, lines 60-67 give the next step which includes heating of the entire substrate from 300°- 550°C, hence will also inherently fulfill the claimed thermal annealing which can also be a post-treatment step. Furthermore, in the making of devices, after ion implanting (claim 10, lines 20-41), laser annealing is preformed again (col. 10, lines 42-67) and then it is taught that "it is important that dangling bonds caused in the process of light annealing....are neutralized by heating them at a temperature of from 250° to 400°C in the atmosphere of hydrogen in a later process" (col. 11, lines 12-16), hence cumulatively showing this concept. Note that Zhang's process involves patterns after the annealing, which is consistent with the concepts of claims 41 and its dependents.

7. Claims 50-51 and 53-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mitanaga et al P.N. 5,808,321 (supplied by applicant in the IDS 1/4/99).

Mitanaga teaches using impurities metals (In, Sn, Sb, Ge, Tl, Pb, Bi, Z, plus various the group III, IV and IV elements, column 3, lines 1-49) as catalyst for crystallization of amorphous Si. Col. 4, lines 15-57 mention sputtering, vapor depositions and ion implanting gas techniques for deposit of the catalyst. Embodiment 1, especially on col. 10, line 16 - col. 11, line 38 give the example of In, first heat treated in H_2 at 550°C, then lamp or laser treated to promote crystallization. Then follows a silicon oxide formation, followed by a heat treatment, the repeat of the lamp heating which further improves the crystal properties. The after a number of steps (col. 12, lines 33-43) a hydrogen anneal is performed on the entire substrate. Atmosphere and temperature are not given for the repeat treatment, however unless otherwise specified, one of ordinary skill in the art would assume that an atmosphere inert to the surface was used, making N_2 obvious. As the surface is heating due to light absorption, temperature above 450°C and consistent with previously taught anneal temperature would have been expected.

8. The disclosure is objected to because of the following informalities: Proof reading to double check figure and reference number correspondence is needed. During previous checking for support, it was noticed that p. 33 incorrectly refers to Fig. 6C and in embodiment 8/Figure 9 series, ref. #904 does not appear to be identified.

Appropriate correction is required.

9. Applicant's arguments filed November 22, 1999 and discussed above have been fully considered but they are not persuasive.

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication should be directed to M.L. Padgett at telephone number (703) 308-2336 and Fax #(703) 305-3599 (after final); and 305-6078 (unofficial).

MARIANNE PADGETT
PRIMARY EXAMINER
GROUP 1700

M.L. Padgett/om
December 1, 2000
December 5, 2000